

**Agency of Natural Resources  
Department of Environmental Conservation**

**Water Quality Division  
Building 10 North  
802-241-3777**

**MEMORANDUM**

To: The record

From: Steve Fiske VTDEC  
Rich Langdon VTDEC

Date: July 12, 2006

Subject: Interpretation of biological assessment data collected by VTDEC and  
USGS, on Pike Hill Brook below the Pike Hill mine site through 2005

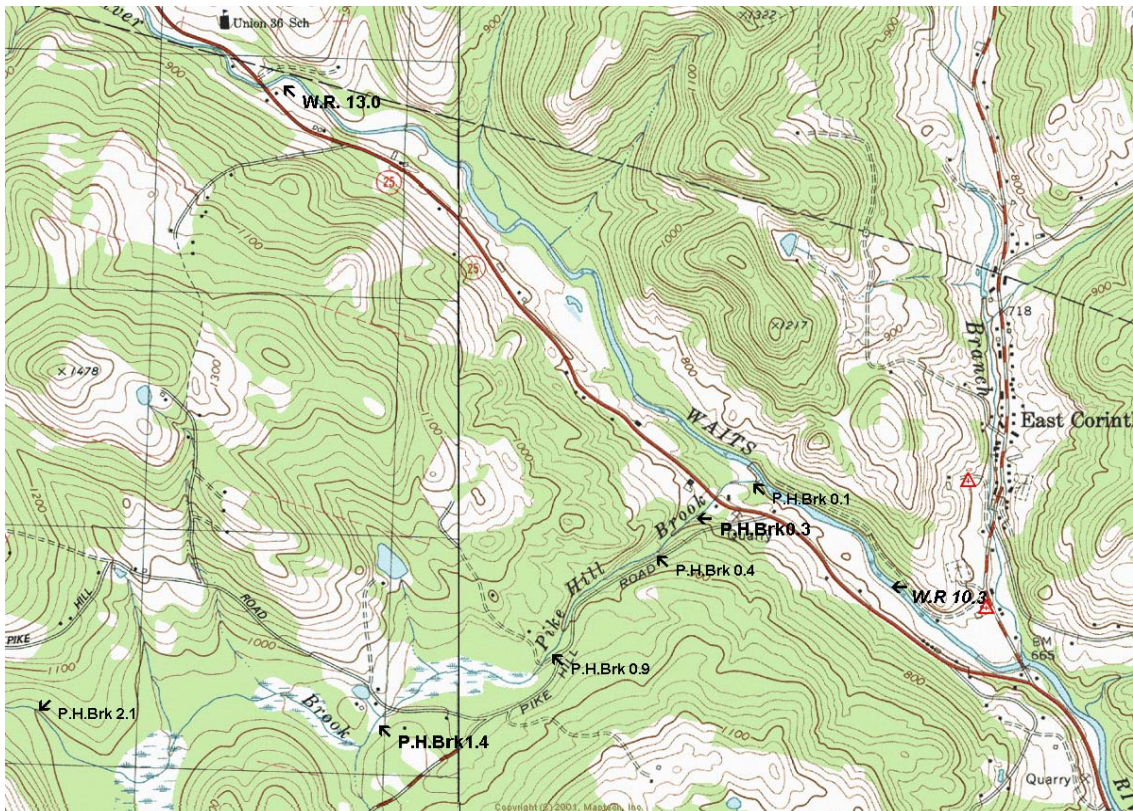
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Pike Hill Brook is located in the town of Corinth, Vt. It is classified by the VTWQ standards as a cold water Class B management type. Biological assessments have shown that the Class B Aquatic Life Support (ALS) is not being met for the entire length of Pike Hill Brook.

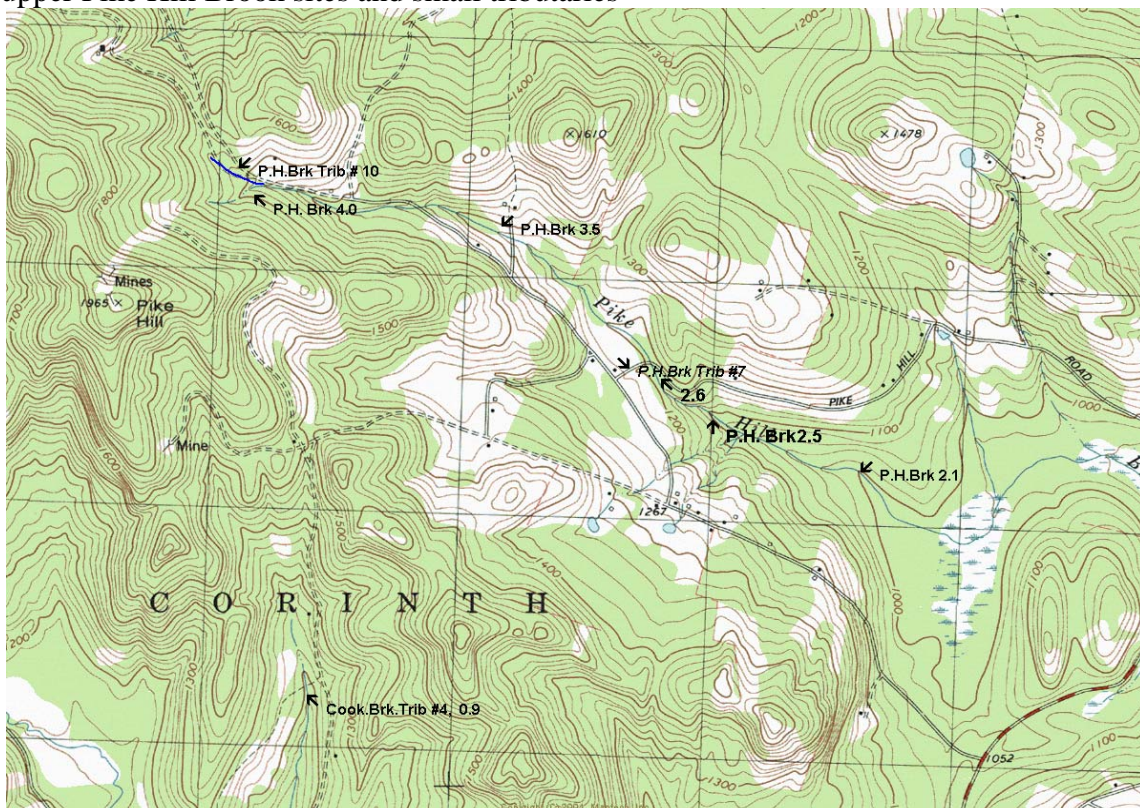
Since 1997 a total of 15 stream sites have been biologically assessed by the VTDEC or USGS on Pike Hill Brook, its tributaries, the Waits River (near Pike Hill Brook ) and Cookville Brook Tributary for either macroinvertebrate (18 sample events) and or fish (5 sample events). The general location of these sites is shown in map **figure 1**. The site watershed characteristics, and specific location (lat - long) and descriptions are shown in **Table 1**. **Table 1** also indicates the community sampled at each site, the macroinvertebrate stream type, and fish IBI type used to assess the biological condition of a site. Two of the uppermost sites on Pike Hill Brook, and a number of very small “reference” tributaries sampled by the USGS in 2005 were considered either too small or had limited riffle habitat to directly apply the biocriteria guidance for the SHG or the Coldwater IBI (CWIBI). These upper Pike Hill Brook sites were assessed using best professional judgment (BPJ) and the local “reference” streams of similar size and habitat type representing their biological potential.



**Figure 1:** Map showing approximate locations of lower and upper biomonitoring sites on Pike Hill Brook, the Waits River, and Cookville Brook, Corinth Vt. Site # refers to River Mile up from confluence for each stream. P.H =Pike Hill, WR=Waits River



upper Pike Hill Brook sites and small tributaries





**Table 1:** Locations of biomonitoring site reaches, and site location attributes in Waits River watershed below Pike Hill Mine.

Location	Site RM	Town	Drainage Area KM <sup>2</sup>	Elevation ft	Latitude	Longitude	Macro-Stream Type	Fish IBI Type	Community sampled
Waits River	10.3	Corinth	130.0	674	440327	721337	MHG		M
Waits River	13	Corinth	123.0	810	440438	721533	MHG		M
Cookville Brook Trib # 4	0.9	Corinth	1.0	1180	440245	721754	SHG/BPJ	CWIBI /BPJ	MF
Pike Hill Brook	0.1	Corinth	11.1	740	440344	721409	SHG		M
Pike Hill Brook	0.3	Corinth	11.0	796	440338	721420	SHG	CWIBI	MF
Pike Hill Brook	0.4	Corinth	10.0	820	440332	721425	SHG	CWIBI	MF
Pike Hill Brook	0.9	Corinth	11.8	910	440321	721444	SHG		M
Pike Hill Brook	1.4	Corinth	9.8	940	440311	721514	SHG	CWIBI	MF
Pike Hill Brook	2.1	Corinth	4.3	1010	440313	721620	SHG		M
Pike Hill Brook	2.5	Corinth	3.2	1117	440322	721645	SHG	CWIBI	MF
Pike Hill Brook	2.6	Corinth	3.1	1190	440324	721651	SHG	CWIBI	MF
Pike Hill Brook	3.5	Corinth	1.3	1275	440345	721720	SHG/BPJ		M
Pike Hill Brook	4	Corinth	0.3	1460	440352	721803	SHG/BPJ		M
Pike Hill Brook Trib #7	0.1	Corinth	1.3	1210	440328	721657	SHG/BPJ		M
Pike Hill Brook Trib #10	0.1	Corinth	0.1	1495	440353	721805	SHG/BPJ		M

Location	Site RM	UGS G Site #	Description
Waits River	10.3	9	Located above snowmobile suspension bridge, about 600m above bridge to East Corinth.
Waits River	13	8	Located at Rt 25 crossing, above Pike Hill Brook confluence
Cookville Brook Trib # 4	0.9	10	Located below log road crossing above beaver pond wetland.
Pike Hill Brook	0.1	7	Located just above confluence with Waits River 50m, below Rt 25.
Pike Hill Brook	0.3		Located above Rt 302 bridge about 1/3 mile
Pike Hill Brook	0.4		Located adjacent to Brook Road, just as road nears the stream up from Rt 25.
Pike Hill Brook	0.9	6	Located below Miller Road.
Pike Hill Brook	1.4	5	Located above 2nd side rd. crossing up from rt.25 about 200m above rd. in riffle area
Pike Hill Brook	2.1	4.5	Located in riffle area immediately above low gradient marshy reach. South of Pike Hill Road.
Pike Hill Brook	2.5		Located below old timber dam below site 2.6, in high gradient gorge area.
Pike Hill Brook	2.6	4	Located below bridge off Flanders rd crossing, 1st bridge below mine.
Pike Hill Brook	3.5	3	Located immediately above Carpenter Place Road.
Pike Hill Brook	4	1	Located above Richardson Road. Near USGS gage sta
Pike Hill Brook Trib #7	0.1		Located just above confluence with Pike Hill Brook
Pike Hill Brook Trib #10	0.1	2	Located above confluence with Pike Hill Brook proper which originates in Pike hill mine.

The Waits River sites are located above and below the confluence with Pike Hill Brook. The macroinvertebrate community was sampled three times, once above and twice below the confluence. These sites were assessed using the MHG stream type biocriteria guidelines, which are presented along with the biometrics and overall assessment results in **Table 2A**. On all sampling occasions the macroinvertebrate community was assessed as *very good or excellent*. In 2005 samples collected by USGS showed both sites to be rated *very good*. Both Waits River site samples were slightly under subsampled (only 10-12% of sample processed at these sites due to a 300 animal USGS subsample vs VTDEC SOP requires minimum of 25%, and 300 animal subsample), likely due to the relatively moderate to high abundance of animals at these sites. This may have effected the richness metrics slightly, but the richness and EPT richness were still in the excellent range well above the median for the stream type. The high richness values and a slightly elevated Bio Index value at both sites is a strong indicator of community compositional shifts toward taxa that are slightly tolerant to enrichment. Both sites were high in scrapers compared to the model for a MHG site. This was mostly due to high numbers of *Helicopsyche borealis*, a scraper caddis fly.

The Pike Hill Brook macroinvertebrate community assessments indicate the most severe impacts occur at the five upper sites from RM 2.1 to RM 4.0; which were consistently rated as poor. The lower sites from RM 0.1 TO 1.4 showed some recovery, with overall ratings ranging from poor to fair at different reaches and years. The extreme upper headwater sites RM 3.5 and 4.0, were assessed against several local control sites due to their small drainage area size and generally lower gradient (**Table 2C**). Compared to the very small local control streams, both sites were extremely low in density, richness, and EPT taxa. The uppermost site 4.0 was also most dissimilar to the SHG model in both order level composition (PMA-O) and functional feeding grp composition. (PPCS-f). The site was also dominated by a single species of *Chironimidae Linnophyes* sp.

The next three sites down from the mine site at RM 2.6, 2.5, and 2.1 were large enough in drainage area to assess directly against the VTDEC small high gradient (SHG) reference type streams. The overall rating of the macroinvertebrate biological condition at these sites was *poor*. The sites were very low in density, Richness and EPT taxa, failing to meet the VT WQ Biocriteria thresholds for the Class B water management classification. In 2002 only five animals were collected from the 2.5 RM site. On all occasions sampled less than 150 animals were collected, a 50% decrease from the minimum threshold

and an 850% decrease from the median of all reference SHG streams. The site at RM 2.6 was slightly higher in richness and EPT taxa than that at RM 2.1 sampled the same year. This is likely due to the RM 2.6 site being located immediately below the unaffected local control Tributary # 7, which would be a likely source of drifting animals into the RM 2.6 location. It is unlikely that these EPT animals become resident to the reach.

The next two sites downstream, RM 1.4 and 0.9, are the first reaches to demonstrate some partial recovery and were rated as *fair* both in 1997 and 2005. In 1997 the EPT richness was low at site 1.4 and low at site 0.9 in 2005. The density was below the minimum expectation at site 1.4 in 2005, and the taxa richness and EPT taxa recovered to a minimum threshold at site 0.9. These sites may be indicating partial recovery for two reasons: they are below a significant beaver impounded stream wetland area, and are also below several small tributaries not affected by the mine which continually drift animals into Pike Hill Brook. It is debatable if these animals are actually able to survive since they do not seem to ever become very abundant within the reach. These two sites also tend to be dominated by taxa that are filter feeders known to be more tolerant of enrichment, and temperature. Again this is likely a localized influence of the wetland areas above these sites. In particular it is the first sites where the filter feeding taxa *Hydropsyche betteni*, *Synphitopsyche morosa*, *Dolophilodes* sp and *Chimarra aterima* appear or become dominant **Table 3**.

The three lowest Pike Hill Brook sites at RM 0.4, 0.3, and 0.1 were sampled in 2005, 2002, and 2005 respectively. The reach of stream above Route 25 at RM 0.3 and 0.4 tended to be in *poor* condition while the site at the confluence of the Waits River indicates recovery to a *fair* condition. Density, richness and EPT was extremely low on both sampling events at the RM 0.3-0.4 sites. This is a typical toxic impact macroinvertebrate community signature. The reach at the confluence with the Waits River RM 0.1 shows considerably higher density, richness and EPT taxa present. The only community metric that does not meet the Class B minimum threshold is EPT/EPT&c ratio, which shows the community is dominated by the generally more tolerant Diptera Chironimidae. The taxa most responsible for this dominance, and the high density is the moderately tolerant *Tvetenia bavarica*. This site is extremely close to the Waits River, as a result it is likely somewhat influenced by colonization from taxa found in abundance in the Waits River.

The fish community was assessed as *poor* at all six sites sampled from RM 0.3 to RM 2.6, but the community metrics and IBI score follow a similar trend of slight recovery at the lower RM sites (**Table 4**). At the upper-most sites sampled- RM 2.5, and 2.6 - only a single brook trout was found. These two sites were virtually fishless, and as such, receive an IBI score of 9, or *poor*. Site 1.4 was also rated as poor, but at least, supported two tolerant species, blacknose dace and creek chub, no brook trout were present, resulting in a community comprised entirely of generalist feeders with no intolerant species resulting in an IBI also of 9, or *poor*. This site is located just below a very low gradient beaver ponded section of stream. As such, it may experience natural stress due to low D.O. and high temperatures. While the two most downstream sites, 0.3 and 0.4, were also rated *poor*, the fish community continued to demonstrate some recovery. CWIBI scores were 18 for site 0.4 and 24 for site 0.3. Three fish species were present: brook trout, blacknose dace, and longnose dace. These sites rated as *poor* due to extremely low numbers of brook trout and high numbers of the two daces.

#### Summary and biomonitoring recommendations

*Pike Hill Brook is impaired over its entire length based on both macroinvertebrate and fish community assessments.* The upper reaches from RM 2.1 to its origin at the Pike Hill mine site is in *poor* condition. The macroinvertebrate community is extremely low in abundance and taxa, and the upper reach is virtually fishless. The lower reaches are slightly improved but remain in *poor-fair* condition. Within lower gradient reaches such as RM 1.4, and 0.9, moderately tolerant macroinvertebrates taxa are present in higher abundances, as are more tolerant fish species. Within higher gradient reaches from RM 0.4 down to RM 0.1, less of a recovery is evident in the macroinvertebrate community and the fish community is still very low in brook trout abundance.

Future monitoring should continue to assess both fish and macroinvertebrate communities. An assessment of the periphyton community and metals precipitate would help to interpret the level of in stream primary productivity and stressors on the macroinvertebrate community. The low gradient habitat type reaches should be isolated more completely and compared against a similar local control stream type, as was done here for the extremely small headwater sites immediately below the mine site. The site near the mouth of the Pike Hill Brook (RM 0.1) will always be somewhat influenced by its proximity to the Waits River, especially for the fish community. The locations above Route 25 are isolated by the

steep drop immediately above Rt 25, so these sites should not be affected by colonization from the Waits River. Biomonitoring assessments should strictly follow the VTDEC collection and analysis protocols. This allows the data to be directly compared to VTDEC aquatic life support biocriteria, and the regional reference expectations for a stream type.

**Table 2A :** Macroinvertebrate assessments from Waits River sites above and below confluence with Pike Hill Brook. Assessments marked with an \* were collected by USGS. Waits River sites are all assessed using the VT MHG stream threshold criteria.

Location	Site RM	Date	Assessment	Density	Richness	Ept	PMA-O	BI	Oligo%	Ept/EptC	PPCS-F
Waits River	10.3	9/5/2002	Exc	1536.0	44.0	28.0	84.0	3.44	0.5	0.90	0.55
Waits River	10.3	8/29/2005*	VGood	2872.0	53.0	24.0	77.7	3.80	0.6	0.87	0.45
Waits River	13	8/29/2005*	VGood	4236.0	55.0	24.0	80.5	4.11	3.1	0.73	0.49
Ref median MHG				1797	45.8	27	83.0	3.20	0.1	0.9	0.64
Class B threshold				>300	>30	>18	>45	<5.00	<12.0	>0.45	>0.40

**Table 2B** Macroinvertebrate community assessments from Pike Hill Brook. Assessments marked with an \* were collected by USGS. Pike Hill Brook sites in table below are assessed using the VT SHG stream threshold criteria. Bolded metrics fail Class B threshold

Location	Site RM	Date	Assessment	Density	Richness	Ept	PMA-O	BI	Oligo%	Ept/EptC	PPCS-F
Pike Hill Brook	0.1	8/29/2005*	Fair	813.6	47.0	16.0	46.8	3.94	2.4	<b>0.30</b>	0.42
Pike Hill Brook	0.3	9/5/2002	Poor	<b>142.0</b>	<b>19.5</b>	<b>9.5</b>	70.2	2.63	0.0	0.81	0.41
Pike Hill Brook	0.4	8/29/2005	F-Poor	<b>103.0</b>	28.0	<b>12.0</b>	62.2	3.50	0.0	<b>0.44</b>	0.45
Pike Hill Brook	0.9	8/29/2005*	G-Fair	502.5	47.0	<b>15.0</b>	59.0	<b>4.68</b>	0.6	0.78	0.63
Pike Hill Brook	1.4	9/10/1997	Fair	433.3	34.0	<b>13.0</b>	60.9	4.08	0.0	0.75	<b>0.30</b>
Pike Hill Brook	1.4	8/29/2005*	Fair	<b>188.0</b>	49.0	17.0	54.4	4.50	3.7	0.62	0.62
Pike Hill Brook	2.1	8/29/2005*	Poor	<b>154.0</b>	<b>22.0</b>	<b>5.0</b>	<b>38.8</b>	2.54	0.6	<b>0.15</b>	0.48
Pike Hill Brook	2.5	9/5/2002	Poor	<b>5.0</b>	<b>4.0</b>	<b>1.0</b>	<b>39.5</b>	4.50	0.0	No c	<b>0.33</b>
Pike Hill Brook	2.6	9/10/1997	Poor	<b>46.0</b>	<b>10.0</b>	<b>5.0</b>	52.4	3.46	0.0	No c	<b>0.28</b>
Pike Hill Brook	2.6	8/29/2005*	Poor	<b>150.0</b>	29.0	<b>10.0</b>	49.8	2.93	0.0	0.80	<b>0.38</b>
Ref median SHG				1016	40	23.5	76.0	2.30	0.2	0.90	0.60
Class B threshold				>300	>27	>16	>45	<4.50	<12.0	>0.45	>0.40

**Table 2C:** Macroinvertebrate community assessments from uppermost reaches of Pike Hill Brook, and local very small reference stream sites. Assessments marked with an \* were collected by USGS. These upper Pike Hill Brook sites in table below are assessed using the local reference streams and bpj. Bolded metrics are considered below Class B bpj expectation

Location	Site RM	Date	Assessment	Density	Richness	Ept	PMA-O	BI	Oligo%	Ept/EptC	PPCS-F
Pike Hill Brook	4	8/29/2005*	Poor	<b>30.0</b>	<b>6.0</b>	<b>2.0</b>	<b>32.8</b>	<b>6.70</b>	0.0	<b>0.16</b>	<b>0.28</b>
Pike Hill Brook	3.5	8/29/2005*	Poor	<b>42.0</b>	<b>16.0</b>	<b>5.0</b>	53.3	2.48	9.5	0.74	0.52
Pike Hill Brook Trib #7	0.1	9/10/1997	Vgood	505.8	35.0	18.0	87.0	2.21	1.8	0.83	0.54
Pike Hill Brook Trib #10	0.1	8/29/2005*	Good	294.0	42.0	10.0	50.3	3.76	4.1	0.51	0.46
Cookville Brook Trib # 4	0.9	8/29/2005*	Good	286.0	41.0	13.0	77.3	3.50	7.0	0.76	0.60
Mean metric values				361.9	39.3	13.7	71.5	3.2	4.3	0.70	0.50



**Table 3:** The percent composition of macroinvertebrate functional feeding grps from streams sites near the Pike Hill mine.

Location	Site	Date	CGath%	CFilt%	Pred%	ShredDet%	ShredrHerb%	Scraper%
Waits River	<b>10.3</b>	8/29/2005	24.8	15.3	7.2	2.2	0.0	49.3
Waits River	<b>13</b>	8/29/2005	51.8	9.6	3.4	5.7	0.6	27.8
Cookville Brook Trib # 4	<b>0.9</b>	8/29/2005	32.2	7.3	39.5	13.6	1.7	3.5
Pike Hill Brook	<b>0.1</b>	8/29/2005	57.2	12.7	21.8	1.5	5.0	1.2
Pike Hill Brook	<b>0.3</b>	9/5/2002	15.2	49.0	24.2	7.1	3.5	0.7
Pike Hill Brook	<b>0.4</b>	8/29/2005	55.3	19.4	21.4	1.0	0.0	2.9
Pike Hill Brook	<b>0.9</b>	8/29/2005	14.0	<b>51.9</b>	17.6	3.0	0.9	11.6
Pike Hill Brook	<b>1.4</b>	9/10/1997	13.7	<b>60.1</b>	5.5	0.0	12.5	8.2
Pike Hill Brook	<b>1.4</b>	8/29/2005	30.3	<b>43.1</b>	17.0	2.7	1.1	3.7
Pike Hill Brook	<b>2.1</b>	8/29/2005	70.1	9.7	11.0	1.9	0.6	6.5
Pike Hill Brook	<b>2.5</b>	9/5/2002	20.0	20.0	0.0	40.0	20.0	0.0
Pike Hill Brook	<b>2.6</b>	9/10/1997	4.3	76.1	8.7	4.3	0.0	6.5
Pike Hill Brook	<b>2.6</b>	8/29/2005	6.7	22.7	22.0	2.7	0.0	44.0
Pike Hill Brook	<b>3.5</b>	8/29/2005	16.7	16.7	21.4	23.8	2.4	0.0
Pike Hill Brook	<b>4</b>	8/29/2005	70.0	0.0	23.3	6.7	0.0	0.0
Pike Hill Brook Trib #7	<b>0.1</b>	9/10/1997	17.2	25.5	10.9	9.9	0.0	19.7
Pike Hill Brook Trib #10	<b>0.1</b>	8/29/2005	27.2	4.8	46.9	12.9	0.0	2.7

**Table 4:** Fish Community Assessments from stream reaches near Pike Hill Mine site, all sites sampled by VTDEC. BT=brook trout.

Location	Site RM	Date	Assessment	CWIBI	TotalRun 1 /100m2	Intolerant Species	Cold Water Spp%	Generalist Feeder %	Top Carnivore%	BT Density #s /100m <sup>2</sup>	No. Brook trout AgeClass
Pike Hill Brook	0.3	9/5/2002	Poor	<b>24</b>	12.1	2.0	87.3	3.9	17.7	2.1	3
Pike Hill Brook	0.4	8/29/2005	Poor	<b>18</b>	5.2	1.0	36.8	0.0	36.8	1.9	2
Pike Hill Brook	1.4	9/10/1997	Poor	<b>9</b>	126.0	0.0	0.0	30.4	0.0	0.0	0
Pike Hill Brook	2.5	9/5/2002	Poor	<b>9</b>	0.0	0.0	0.0	0.0	0.0	0.0	0
Pike Hill Brook	2.6	9/10/1997	Poor	<b>12</b>	0.5	1.0	100.0	0.0	100.0	0.5	1
Cookville Brook Trib # 4	0.9	8/29/2005	Excellent	<b>42/ BPJ</b>	52.0	1.0	100.0	0.0	100.0	52.0	3